

Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) EP 1 045 135 A3

(12)

EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
10.07.2002 Bulletin 2002/28

(51) Int Cl.7: F02M 51/06, F02M 61/16

(43) Date of publication A2:
18.10.2000 Bulletin 2000/42

(21) Application number: 00104454.4

(22) Date of filing: 06.03.2000

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: 13.04.1999 JP 10525399

(71) Applicant: Hitachi, Ltd.
Chiyoda-ku, Tokyo 101-8010 (JP)

(72) Inventors:
• Tsuchiya, Masahiro
Tsuchiura-shi, Ibaraki 300-0011 (JP)
• Hirata, Tousuke
Inashiki-gun, Ibaraki 300-0332 (JP)
• Okamoto, Yoshio
Higashiibaraki-gun, Ibaraki 319-0102 (JP)

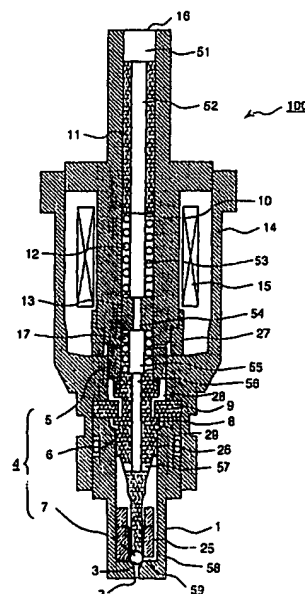
- Ishikawa, Tohru
Kitaibaraki-shi, Ibaraki 319-1702 (JP)
- Maekawa, Noriyuki
Niihari-gun, Ibaraki 315-0053 (JP)
- Tanabe, Yoshiyuki
Hitachinaka-shi, Ibaraki 312-0011 (JP)
- Sekine, Atsushi
Hitachinaka-shi, Ibaraki 312-0061 (JP)
- Kadomukai, Yuzo
Ishioka-shi, Ibaraki 315-0035 (JP)
- Yamakado, Makoto
Tsuchiura-shi, Ibaraki 300-0007 (JP)
- Abe, Motoyuki
Niihari-gun, Ibaraki 315-0054 (JP)

(74) Representative: Beetz & Partner Patentanwälte
Steinsdorfstrasse 10
80538 München (DE)

(54) Fuel-injection valve

(57) A fuel-injection valve (100) includes a fuel-injection hole (2), a valve element (4) and a valve seat (3) for opening and closing the fuel-injection hole, a force-applying member (12) for applying force to the valve element in a direction of motion of the valve element, and a drive unit (5, 10, 14, 15) for applying force to the valve element (4) in the direction opposite to that of the force applied by the force-applying member; wherein a secondary oscillation system (13, 17), which interacts with a primary oscillation system (14, 12) including the valve element (4) and the force-applying member (12), is added to the primary oscillation system, and the phase angle of force applied to the primary oscillation system by the secondary oscillation system is also staggered from that of force applied to the primary oscillation system, which is other than the force applied to the primary oscillation system by the secondary oscillation system; whereby the bouncing of the valve element during opening and closing of the valve is reduced, which in turn makes it possible to achieve very accurate fuel-injection control.

FIG. 1





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 10 4454

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 4 749 892 A (MESENICH GERHARD) 7 June 1988 (1988-06-07) * column 3, line 40 - column 5, line 30; figures 1-4 *	1-3,15, 19	F02M51/06 F02M61/16
X	US 4 766 405 A (DALY PAUL D ET AL) 23 August 1988 (1988-08-23) * column 2, line 47 - column 4, line 47; figures *	1-4,19	
X	US 5 328 100 A (BERGSTROM JOHN S ET AL) 12 July 1994 (1994-07-12) * column 2, line 43 - column 3, line 8; figures *	1-3,7,19	
X	US 5 207 387 A (BERGSTROM JOHN S) 4 May 1993 (1993-05-04) * column 2, line 31 - line 55; figures 1,2 *	1-3,8,9, 13,15,19	
X	US 4 878 650 A (DALY PAUL D ET AL) 7 November 1989 (1989-11-07) * abstract *	1,2	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A		15	F02M
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 22 May 2002	Examiner Torle, E
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.02 (P4001)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 10 4454

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-05-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4749892 A	07-06-1988	DE 3314899 A1	25-10-1984
		FR 2544801 A1	26-10-1984
		GB 2140626 A , B	28-11-1984
		IT 1175836 B	15-07-1987
		JP 59205084 A	20-11-1984
US 4766405 A	23-08-1988	AT 63654 T	15-06-1991
		AU 614080 B2	22-08-1991
		AU 1625988 A	04-11-1988
		BR 8807459 A	22-05-1990
		CA 1291175 A1	22-10-1991
		CN 1030125 A	04-01-1989
		DE 3862868 D1	20-06-1991
		EP 0382721 A1	22-08-1990
		ES 2007199 A6	01-06-1989
		JP 7062503 B	05-07-1995
		JP 2501084 T	12-04-1990
		WO 8808199 A1	20-10-1988
US 5328100 A	12-07-1994	CN 1090909 A	17-08-1994
		DE 69306122 D1	02-01-1997
		DE 69306122 T2	30-04-1997
		EP 0662194 A1	12-07-1995
		WO 9407021 A1	31-03-1994
US 5207387 A	04-05-1993	EP 0596990 A1	18-05-1994
		JP 7500161 T	05-01-1995
		WO 9303272 A1	18-02-1993
US 4878650 A	07-11-1989	DE 68900882 D1	02-04-1992
		EP 0411041 A1	06-02-1991
		JP 2670874 B2	29-10-1997
		JP 3502227 T	23-05-1991
		WO 8910478 A1	02-11-1989

EPO FORM P4489

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82